

13448

COASTAL ZONE  
INFORMATION CENTER

WP



# Texas Coastal Management Program

Texas General Land Office.

TD  
195  
.P4  
C373  
1978

Texas Coastal Management Program  
Technical Paper No. 19

A CASE STUDY OF PETROCHEMICAL  
FACILITY SITING:  
THE CORPUS CHRISTI PETROCHEMICAL COMPANY

U. S. DEPARTMENT OF COMMERCE NOAA  
COASTAL SERVICES CENTER  
2234 SOUTH HOBSON AVENUE  
CHARLESTON, SC 29405-2413



The General Land Office of Texas  
Bob Armstrong, Commissioner

**Property of CSC Library**

RPC, Inc.  
Austin, Texas

August 1978

SEP 10 1997

This is one of a series of technical papers, which cover a variety of topics. For information concerning other technical papers in this series, or to order more copies of this paper, contact:

Elizabeth Christian Wilds  
RPC, Inc.  
1705 Guadalupe  
Austin, Texas 78701

This paper was prepared under contract with the General Land Office of Texas, Coastal Management Program. The report was partially funded through financial assistance provided by the Coastal Zone Management Act of 1972, administered by the Office of Coastal Zone Management, U.S. Department of Commerce.

## FOREWORD

This technical paper is one of four papers which provide additional information relevant to the study entitled Siting Industrial Facilities on the Texas Coast. Many individuals assisted in the production of these technical papers. Public officials, private citizens, and industrial representatives provided invaluable assistance.

The principal-in-charge was Ron Luke. Project managers were Leah Pagan and Frank Sturzl. The principal research was conducted by Leah Pagan with assistance from Chet Allerhand and Barbara Haefeli. The technical editor was Nancy Grona. Production assistance was provided by Kyle Pierce and Lori Snyder.

A handwritten signature in black ink, reading "Bob Armstrong". The signature is written in a cursive style with a large, prominent "B" and "A".

Bob Armstrong, Commissioner  
General Land Office of Texas

## TABLE OF CONTENTS

|  | <u>Page</u> |
|--|-------------|
| 1. Introduction . . . . .  | 1           |
| 2. History of the Company . . . . .                              | 3           |
| 3. Management Structure of the Company . . . . .                 | 5           |
| 4. The Facility . . . . .  | 7           |
| 5. General Petrochemical Siting Requirements and Constraints . . | 11          |
| 6. The CCPC Siting Process . . . . .                             | 13          |
| 7. The CCPC Permitting Process . . . . .                         | 19          |
| State Permits . . . . .  | 20          |
| Federal Permits and Requirements . . . . .                       | 21          |
| Permits for Associated Operations . . . . .                      | 24          |
| 8. Opposition to the CCPC Facility . . . . .                     | 27          |
| 9. Local Impacts of the CCPC Facility . . . . .                  | 29          |
| Environmental Impacts . . . . .                                  | 29          |
| Economic Impacts . . . . .                                       | 30          |
| Social Impacts . . . . .   | 31          |
| 10. Summary. . . . .   | 33          |
| References . . . . .   | 35          |

## LIST OF MAPS

|   | <u>Page</u> |
|---|-------------|
| 1. Texas Lower Coast Area . . . . .                               | 8           |
| 2. Corpus Christi Area . . . . .                                  | 9           |
| 3. Corpus Christi Petrochemical Company Site and Surrounding Area | 16          |

## LIST OF FIGURES

|   | <u>Page</u> |
|---|-------------|
| 1. Future Permitting of Associated Operations . . . . . | 25          |

## 1. INTRODUCTION

In March 1977, the Corpus Christi Petrochemical Company (CCPC) began site preparation for a plant designed to manufacture 1.2 billion pounds of ethylene per year, as well as ancillary chemicals. Official ground-breaking ceremonies were held three months later, in June, and construction continues at the present time. CCPC is a joint venture of the subsidiaries of the Champlin Petroleum Company (37.5%), ICI United States (37.5%), and Soltex Polymer Corporation (25%). CCPC and its new plant represent a number of trends in the petrochemical industry today. These include:

1. The diversification of related industries into the petrochemical sector
2. The use of liquid feedstocks, namely naphtha and gas oil, in the production of ethylene
3. The investment of a substantial amount of capital in the construction of a large plant facility

Although representative of numerous innovations in the petrochemical industry, CCPC joined the many firms which have chosen to locate on the Texas Gulf coast. In fact, by volume, the Texas Gulf coast has the greatest concentration of chemical plants in the United States, producing more than 40 percent of every basic petrochemical, 80 percent of the synthetic rubber, and 60 percent of the nation's sulfur (Whitehorn, 1973). There are 58 petrochemical plants operational at the present time in the Texas coastal area. At least 10 additional plants are currently proposed or under construction in this area.

It is important to clarify the usage of the term "petrochemicals" in this study. Usually the term refers to those chemicals derived or isolated from petroleum or natural gas. According to Whitehorn, both first-line raw materials and monomers, as well as polymers and plastics, are sometimes included under the rubric of petrochemicals (1973). Generally, though, "petrochemical" is not used to refer to fuel or energy products such as gasoline, natural gas, and kerosene. While the manufacture of numerous consumer goods such as drugs, fertilizers, and synthetic fibers depends heavily on petrochemicals, these end products themselves are not generally thought of as petrochemicals. In this study, the term is used to include raw materials, monomers, polymers, and plastics, but not fuel, energy, or end products.

The plant being constructed by CCPC will produce ethylene as its major product. Ethylene is by far the most commonly produced petrochemical and leads all other petrochemicals in dollar value of sales. It is part of the class of petrochemicals known as olefins, which also includes butadiene (a diolefin), propylene, and various butylenes. As in the case of the CCPC plant, the production of ethylene is often accompanied by the production of these other olefins.

The Gulf coast produces approximately 60 percent of the nation's olefins, according to the 1974-75 Houston Gulf Coast Chemical Directory. The development of this particular industry on the Texas coast is linked to the area's production and refining of oil and gas. Historically, ethylene plants have used liquefied petroleum gas (LP gas) as feedstock. However, shortages of natural gas liquids have encouraged the industry to turn to such feedstocks as naphtha and distillate fuels, which are produced from crude oil. While only about five percent of the current United States petroleum demand is used as feedstock for the petrochemical industry, there is a growing shortage of traditional feedstocks (Whitehorn, 1973).

The CCPC plant's reliance on naphtha and gas oil as feedstock affects both the size of the plant and the variety of its products. The use of these feedstocks for ethylene production also increases the production of propylene, butadiene, and benzene. CCPC reflects the trend toward the construction of large, integrated complexes which produce a variety of products, rather than just ethylene.

However, the cost of these larger plants is relatively high. This cost, coupled with the importance of a steady supply of feedstocks, has led a number of petrochemical companies to consider joint ventures in the construction of new ethylene plants.

In the CCPC case, though, it was Champlin Petroleum Company that initiated the partnership. In general, joint ventures are attractive to both petrochemical firms and oil companies because the former can provide expertise in construction and operation of a plant and often a market for primary chemicals, such as ethylene, while the latter can provide feedstocks and needed capital. Certainly both types of firms are drawn to the increasing profitability of petrochemical production. (Unfortunately, the exact figures on profitability of petrochemical activities cannot be obtained since these particular activities of companies are included with other chemical and nonchemical activities in Department of Commerce figures. At the present time, though, a return of 10 to 15 percent is expected, according to a CCPC official.)

The Corpus Christi Petrochemical Company reflects all these various trends. It is a joint venture of oil and chemical companies. The facility will be large, and the capital investment significant. Liquid feedstock will be used in the production of ethylene, propylene, benzene, butadiene, and various butylenes.



## 2. HISTORY OF THE COMPANY

According to Mr. Richard J. Carlton, CCPC facilities project director and a Champlin employee, Champlin Petroleum Company, headquartered in Fort Worth, decided in 1973 to diversify into petrochemicals. Champlin, which was once a subsidiary of Celanese and is now a subsidiary of Union Pacific Corporation, was preparing at that time to significantly expand its Corpus Christi refining facility, and thus could provide feedstocks to a petrochemical plant. Chemical Engineering (1976) states that Champlin hoped "to avoid seasonal fluctuations in production rates by sending excess products to the ethylene plant. And the company . . . (saw) more profit in the chemical markets."

Champlin investigated several joint venture possibilities after initial feasibility studies confirmed such a project was viable. In 1975, Champlin representatives visited Imperial Chemical Industries Limited of the United Kingdom (ICI), the parent company of ICI United States. Champlin also approached Solvay and Cie S.A. of Brussels, Belgium, the parent company of the U.S. firm, Soltex Polymer. Both parent companies have extensive experience in petrochemical production and end product manufacture.

Solvay and Cie has 100 subsidiaries in 15 countries and has been involved in the production, processing, and marketing of petrochemicals. Imperial Chemical Industries (ICI) has been heavily involved in the manufacture of chemicals, plastics, pharmaceuticals, and fibers as well as oil and gas exploration and production. In addition, ICI was one of the pioneers in the area of production of ethylene from liquid feedstocks, such as naphtha. Chemical Age's 1975 list of the largest worldwide chemical companies places ICI as third largest and Solvay and Cie as the nineteenth largest (Chem. Systems, Inc., 1976).

ICI United States, which operates a facility at Baytown, and Soltex Polymer, which operates one at Deer Park, both have or plan to have a demand for ethylene or propylene. They, then, will be two of the primary buyers of CCPC products, while Champlin will supply the feedstocks.

The three companies agreed to pursue the joint venture approach to a large olefins complex in late 1975. During 1976 a feasibility study was conducted, and the drafting of necessary partnership legal documents commenced. While the contents of the feasibility study are considered proprietary information by officials of CCPC, they generally addressed the financial feasibility and management structure of the

venture (Carlton, 1977; Fleming, 1977). During this same period a variety of other studies directed at siting the facility were done internally (Fleming, 1977).

The three companies signed formal partnership papers on November 15, 1976. To advance the project as rapidly as possible, the original application for a construction permit to the Texas Air Control Board was made by Champlin. It was not until spring of 1977 that the name on the permit application was changed to Corpus Christi Petrochemical Company. The partners' agreement to use an operational ICI plant as a model, ICI's experience in construction of large integrated plants, and engineering studies done in 1976 allowed construction to begin early in the spring of 1977.

### 3. MANAGEMENT STRUCTURE OF THE COMPANY

All of the principals of CCPC are presently on loan from the three companies involved in the joint venture. For instance, Richard Carlton, the facilities project director, is a Champlin employee who formerly worked at Champlin's corporate headquarters in Fort Worth and at the Champlin refinery in Corpus Christi; Alstair Fleming, the deputy facilities project director, is an ICI employee and has been involved in the construction of a number of ICI facilities. In fact, many of the engineers and technical advisors are from a recently completed ICI facility in England. Champlin has also furnished engineers for the project team. Soltex Polymer Corporation has provided an advisor/consultant and has several other employees involved in the project.

Company policies are implemented through the executive committee. This committee prepares items for submission to the policy panel, and it is also composed of one representative from each of the parent companies.

In a June 1977 edition of the Corpus Christi Caller-Times, which contained numerous articles on the CCPC project, the names of the members of two other CCPC committees are given. These committees, the legal committee and the financial committee, are "a functional part of the organization" (Carlton, 1978).

The project team is primarily responsible for the construction of the plant. This team was involved in the original planning of the project and has played the major role in the permitting process. The facilities project director and the deputy facilities project director lead this team and are assisted by advisor consultants, managers (technical, construction, operations, and logistics), and engineers (pipelines, instrument, process, scheduling, process, and project).

The office of general manager, who heads the operations team, is presently vacant. He and the operations team will play an important role when the plant becomes operational in early 1980. The marketing team, which is currently negotiating sales of products, will continue this effort after construction of the plant is completed.

Thus, it is primarily the project director and the deputy project director who report to the executive committee at the present time. They are authorized to make large expenditures and manage the project. The facilities project director is officed in Houston at the main CCPC

office, and the deputy director is officed in Corpus Christi at the construction site.

In addition to those mentioned above, there are a number of other persons actively involved in the CCPC project. Several law firms have been employed as legal consultants, including Vinson & Elkins of Houston and Brown, Maroney, Rose, Baker and Barber of Austin. Both have represented CCPC at various permitting hearings. CCPC has employed Engineering Science, Inc. of Austin as environmental consultants. The engineering design was done by the New York firm of Stone and Webster, and Brown and Root is constructing the facility.

It should be noted here that Chemical Engineering describes two major drawbacks to joint ventures (1976). One of these is the problem of management. Since joint ventures are usually hybrids, the management seldom answers to a single authority. Although CCPC officials denied any such problems, it is true that the project directors still report to their former employers and plan to return to them after construction of the plant (Carlton, 1977; Fleming, 1977).

The other major drawback to creation of these hybrid firms, according to Chemical Engineering, is the possibility of government antitrust intervention. The article quotes Alfred F. Dougherty, formerly the director of the Federal Trade Commission's Bureau of Competition:

The Federal Trade Commission is concerned about the seeming propensity of major firms in these two industries (oil and chemicals) to get together; but each joint venture has to be measured on its merits.

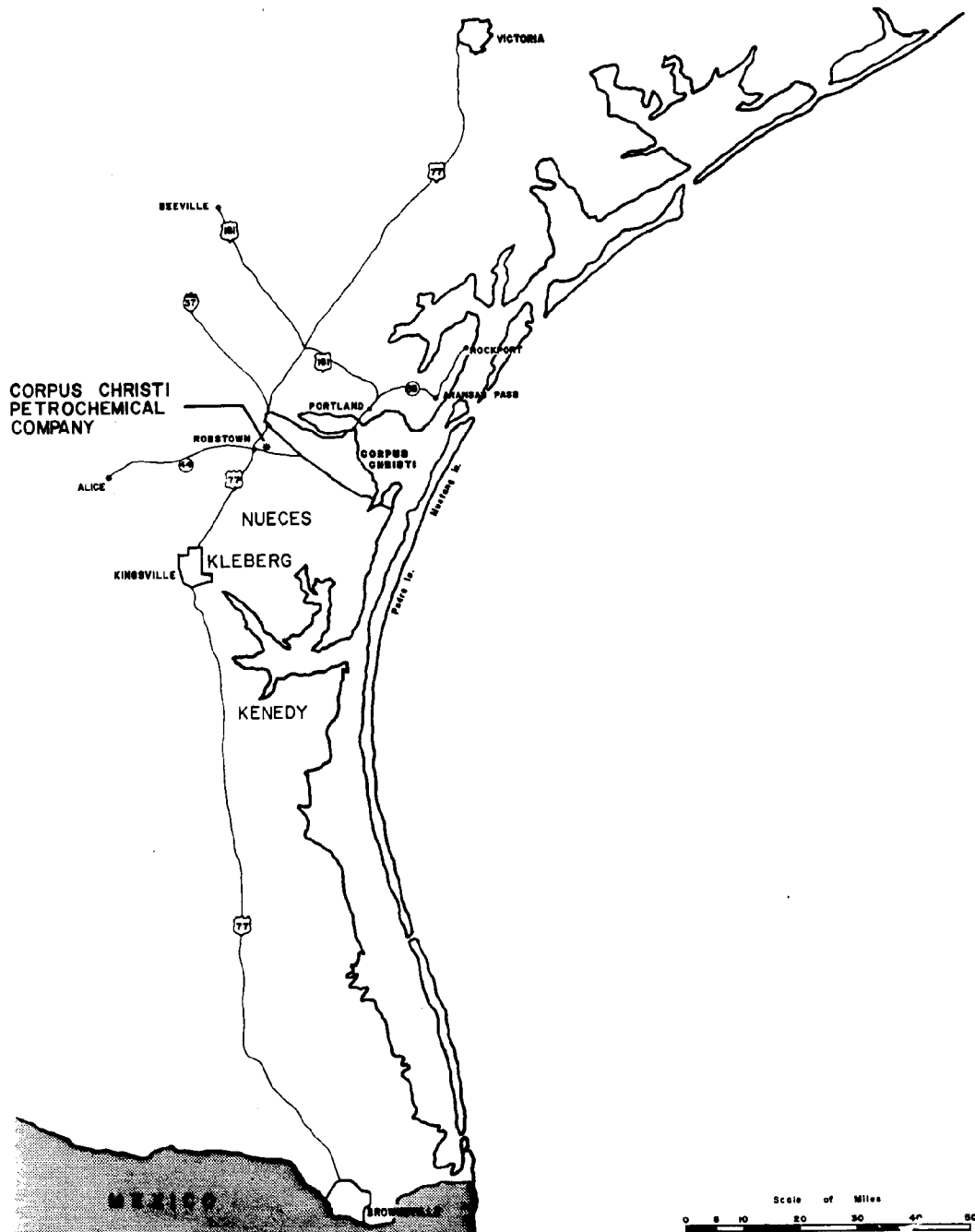
#### 4. THE FACILITY

The CCPC plant under construction in Corpus Christi is modeled after an ICI, Ltd. facility in England. While the Corpus Christi plant will have certain unique features, the partial duplication of the plant reduced the amount of time needed to design the facility. The estimated cost of the entire complex is approximately \$600 million, and the plant will be capable of manufacturing 1.2 billion pounds per year of ethylene and other ancillary petrochemicals. Maps 1 and 2 show the location of the CCPC plant.

The plant is being constructed on a 1,200-acre tract of land 4.5 miles east of Robstown, abutting State Highway 44 (Agnes Street) and continued between Farm-to-Market Road 24 (Violet Street) and McKenzie Road. The facility is outside of the Corpus Christi city limits but within its extraterritorial jurisdiction (ETJ). The plant site is outside of the Corpus Christi Industrial Zone in an area not currently used by major industries. Specifics about this site and the factors leading to its choice will be discussed later in the study.

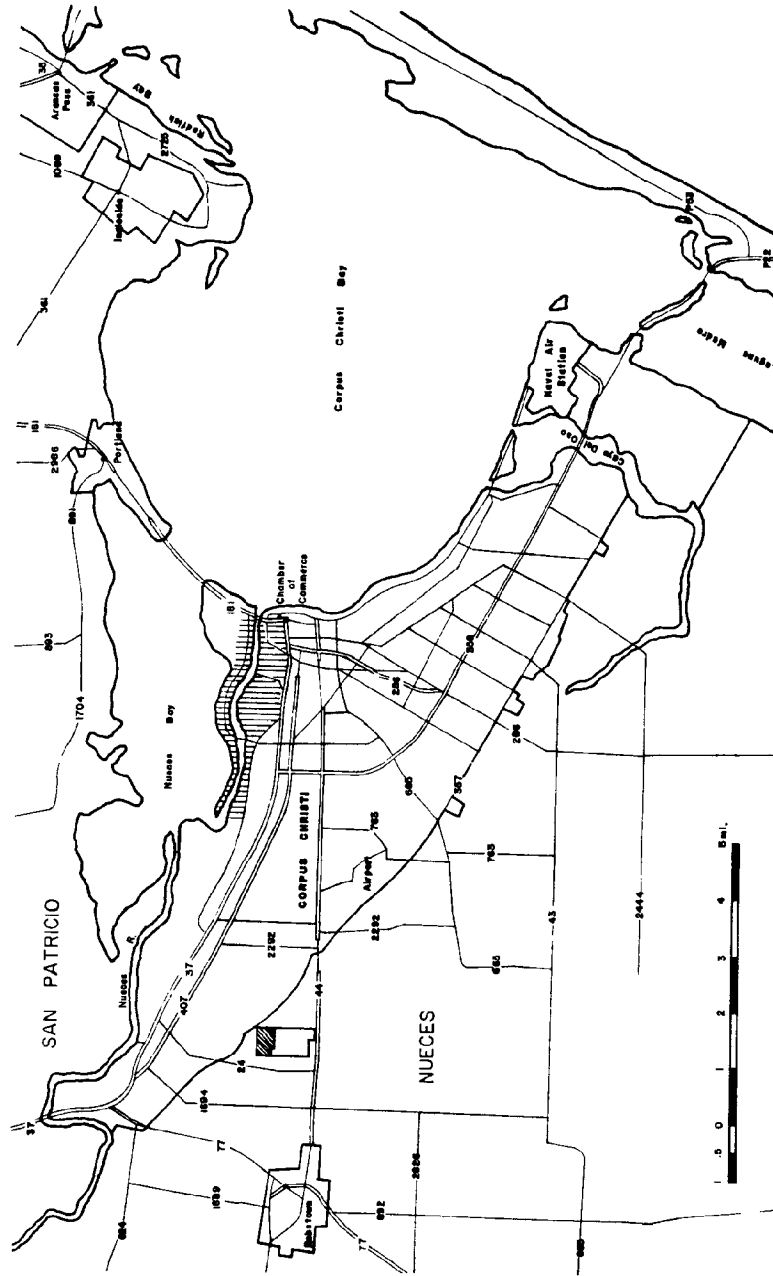
In addition to the facility in which the chemicals are actually produced, CCPC plans to build a number of support facilities on the site. These include necessary utility systems, a water treatment and disposal unit, a solid waste disposal system, and storage tanks. Pipelines will be run to the Champlin refinery and the port area for the transfer of feedstocks and byproducts. Pipelines to the Houston area will be constructed to move the ethylene and propylene to this market, and salt domes will be used as storage sites for the petrochemicals.

Map 1  
TEXAS LOWER COAST AREA



Source: Texas Official Highway Travel Map.

Map 2  
CORPUS CHRISTI AREA



EXISTING MAJOR INDUSTRIAL AREA  
CORPUS CHRISTI PETROBRAS  
COMPANY INITIAL SITE DEVELOPMENT

Source: Texas Official Highway Travel Map.

## 5. GENERAL PETROCHEMICAL SITING REQUIREMENTS AND CONSTRAINTS

A number of sources provide general discussions of the siting requirements of a petrochemical complex. The requirements and constraints generally considered fall into the following broad categories:

1. Availability of raw materials
2. Proximity to markets
3. Availability of land, water, and utilities
4. Availability of labor and general labor climate
5. Adequate transportation networks
6. Legal requirements and taxes
7. Housing availability and local living conditions

There are at least four distinct levels of decisions involved in the siting of a petrochemical facility, and each level involves different considerations. The major siting decisions involve selection of a country, selection of a state (in the U.S.), selection of an area, and selection of a specific site. While the latter two decisions are the primary concern of this study, the former two should be discussed briefly.

The growing number of foreign companies entering the United States petrochemical market is based largely on the proximity to markets and, to some extent, on the availability of raw materials. The United States manufactures and consumes great quantities of petrochemicals, and the U.S. petrochemical market continues to expand. The heavy taxes levied in European countries, the expanding U.S. markets, and the generally stable political climate have combined to make the U.S. increasingly attractive to foreign firms. Within the U.S., Texas has been and continues to be the site of a high percentage of the nation's petrochemical facilities. Texas has abundant raw materials, expanding markets, adequate supplies of labor, transportation facilities, water, and utilities; a favorable tax structure; and a favorable economic, labor, and living environment. In addition, in many areas local authorities and citizens support industrial expansion.

Of course, few areas offer all of the conditions listed above. For instance, the upper Texas coast in and around Beaumont has a higher percentage of unionized labor which is seen by some firms as a siting constraint. Other areas do not have adequate port facilities. The lower coast in and around Brownsville is somewhat removed from both raw materials and markets of the petrochemical industry. Location of



petrochemical plants in this area would involve high transportation costs at the present time, and there are few pipeline networks in this area (Allen, 1977).

The Houston area, which has long been the site of numerous petrochemical plants, now has little available land. In addition, the presence of extensive industrial development in this area may tend to inhibit future development as the result of federally mandated clean air and water requirements. The federal offset policies require that for any new or expanded industrial facility to be constructed in a nonattainment area - that is, an area where the air quality is below the national standard - more than equivalent offsetting emission reductions must be obtained from existing facilities in that area. Thus, federal "offset" policies do encourage industries to locate plants where emission offset is available. For instance, in a relatively nonindustrial area it may be difficult, if not impossible, for a company to purchase or acquire the necessary offset emissions.

Given these general constraints in other Texas coastal areas, it is not surprising that the middle coastal area is the site of increased industrial activity. This area generally has adequate water, labor, land, and utilities. Feedstock is available, and the transportation of the petrochemical products to the major markets is not overly expensive nor difficult. In fact, there is a petrochemical pipeline extending from the Victoria area to the major markets of the Houston and the Beaumont areas. Permits at the local level and air quality permits at the state and federal levels are obtainable due mainly to the generally good air and water quality as compared to the upper coast. The widespread pro-development attitude of local officials and citizens also makes this area attractive to industry.

While much of the Texas middle and lower coastal area has retained a largely agricultural, tourist, or fishing economy, some areas have experienced extensive industrialization. Corpus Christi is one such area. Industrial development adjacent to the Corpus Christi port facility has been particularly extensive; there is now little suitable land available in that area. Though Central Power and Light Company has sufficient electrical utility capabilities to allow for industrial expansion, the area has a limited supply of fresh water. However, the city is currently involved in the proposed construction of a dam (Choke Canyon Dam) in Live Oak County. This project should supply the Corpus Christi area with sufficient fresh water for future expansion; however, the dam will not be operational for some time.

## 6. THE CCPC SITING PROCESS

From the beginning of the CCPC project, Champlin Petroleum Company preferred the Texas Gulf coast. When the issue of a refinery tax was raised in Texas in 1976 and 1977, CCPC did temporarily investigate the possibility of siting in Louisiana, but refocused on Texas when the policy was not enacted (Carlton, 1977). A number of Texas coastal sites were considered, including sites along the upper Houston ship channel, a site near the Deer Park plant of Soltex Polymer, and one near the Baytown plant of ICI United States. These sites would have placed the plant near the major petrochemical market, an increasingly important consideration. Although proximity to raw materials certainly brought petrochemical industries to Texas, the access to product markets, or "downstream consuming units," is currently an equal, if not more important, factor in the siting decision (Fleming, 1977). Major constraints to locating the CCPC facility in the above areas were the possibility of permitting problems and availability of land and cost of land at certain sites (Carlton, 1977).

One note should be added here to clarify the discussion on proximity to market which was presented earlier. While it is true that Corpus Christi is not currently a major market for ethylene and its associated chemicals, there does exist a major petrochemical pipeline network which extends up the coast from Victoria. In addition, CCPC plans to build its own pipelines from Corpus Christi to the Houston area. It is also possible that pipelines could hook into the Victoria-Houston system. It is a common practice in the petrochemical industry to "swap" pipelined products. In effect, this means that CCPC or another plant can introduce a given amount of ethylene into their end of the pipeline system, and a firm upline may buy this amount immediately. Thus, though the Corpus Christi site will not place the plant at the "heart" of the market, transportation of products to the market is not difficult.

The facilities project director stated there were four major reasons for selection of Corpus Christi over the other areas (Carlton, 1977):

1. Ability to obtain necessary permits at the local, state, and federal levels
2. Availability of land
3. Port facilities
4. Proximity to raw materials

This officials also stated that the company considered quality of life factors in their decisions. Not only were such factors as housing availability and cost of living considered, but other less tangible factors were also considered. To quote a CCPC official: "You want to look around for a place where people want to live" (Carlton, 1977).

However, certainly the most important factor in the siting of the facility in Corpus Christi was Champlin's location in this area. In fact, in 1974, Champlin had purchased 500 acres near its refinery and the port and hoped to use this for the plant site. For several reasons this acreage proved unsuitable. Similarly, the director of the Corpus Christi Industrial Commission reported that local officials did not have to "sell" the area to the company as is often the case in industrial siting (Allen, 1977).

While the proximity of the Champlin refinery was certainly an important consideration, the company's enthusiastic support of the area was also based on relative ease of permitting as compared to other Texas areas. The Corpus Christi area is an EPA nonattainment air quality region as is most of the coast of Texas. Champlin officials felt they could obtain the necessary permits to locate in the Corpus Christi area (Hutchinson, 1978). Champlin anticipated greater problems in permitting a plant in or near the Houston area, which is a major petrochemical market. Thus, Corpus Christi provided both the possibility of permitting of the facility and relative proximity to petrochemical markets. According to a Champlin Company official, the need to purchase offset emissions from the Champlin refinery was not an issue since the EPA's interpretive ruling of the emission offset policy was not published until after the Corpus Christi site had been chosen (Hutchinson, 1978). However, as discussed later, EPA's ruling has resulted in the provision of offset emissions by the Champlin refinery to the CCPC facility.

After the partners agreed to site the plant in the Corpus Christi area, a somewhat different set of factors was used to determine the specific site. According to Fleming, deputy facilities project director, all of the following factors, among others, were considered:

1. Access to raw materials (feedstocks)
2. Explicitness of permitting
3. Safety
4. Land availability and cost
5. Soil characteristics
6. Access to wastewater disposal streams or ditches
7. Subsidence and runoff patterns
8. Character of surrounding area
9. Availability of utilities

By gradually eliminating various areas, the present site was chosen.

One particularly attractive parcel of land was eliminated as a site for a rather interesting reason. This site was rejected by one of the partners due to the potential safety hazard posed by its proximity

to airport flight patterns (Allen, 1977). While this land was not within an area generally considered as potentially unsafe due to patterns, one partner, based on experience overseas, preferred to locate the plant elsewhere.

As can be seen from Map 3, the site for the CCPC plant is not adjacent to the port area. In fact, the CCPC site is approximately five miles from the port area and its major facilities. The unusual choice of this landlocked site was made feasible by plans to pipe feedstock from the Champlin refinery and to buy 25 to 50 acres of dock space along the harbor.

It should also be noted that the selected site is outside of the city limits of Corpus Christi. Historically, the city of Corpus Christi has promoted industrial development outside of the city limits. The Corpus Christi Industrial Zone is an area along the port which is not within the city limits. Industries in this area pay school taxes to the Corpus Christi Independent School District and county taxes to Nueces County, but they do not pay city taxes.

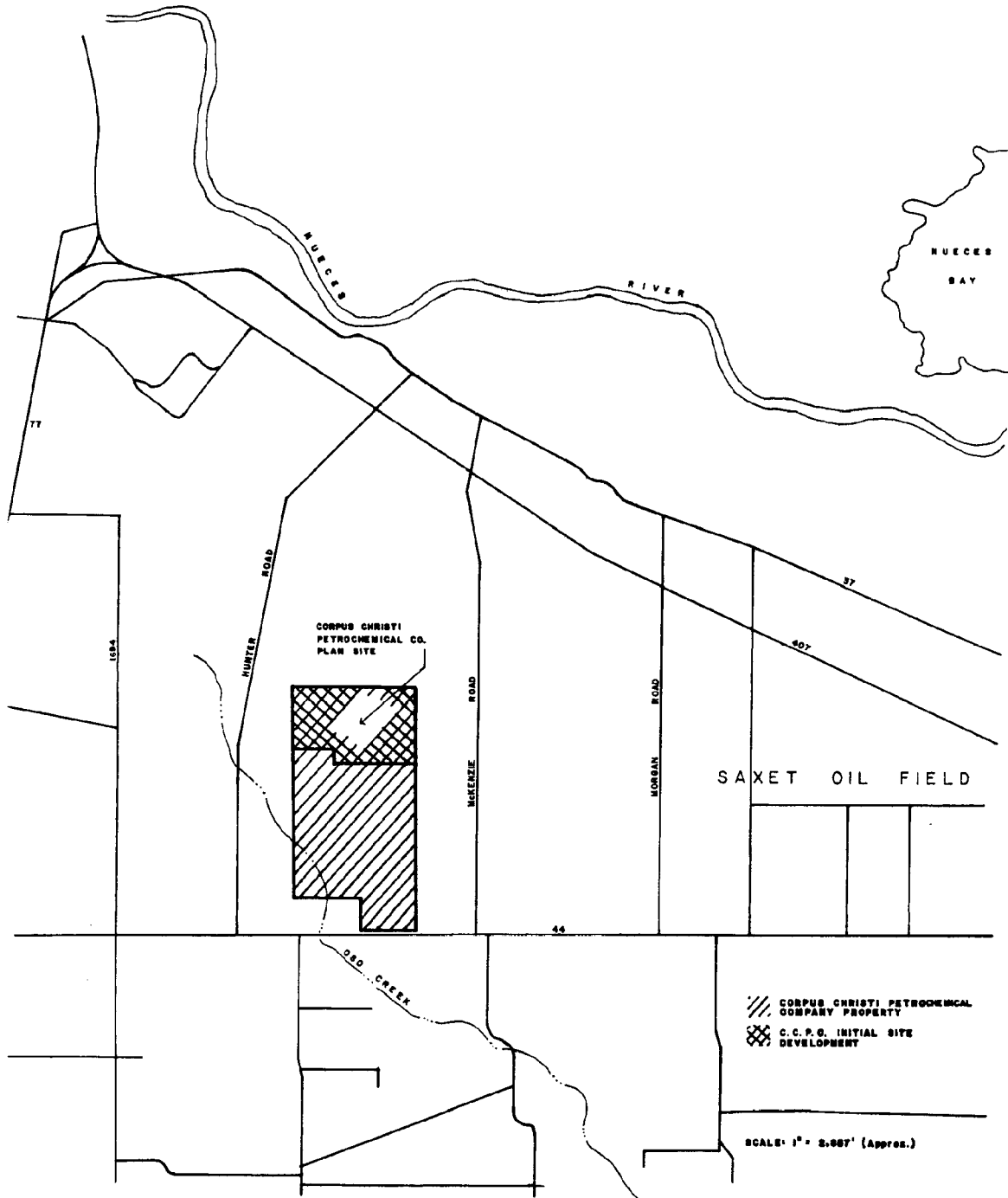
It is not only the private sector which has seen benefits from this industrial zone. In a document entitled Choices Facing Corpus Christi (1975), the Corpus Christi Goals Commission states that this unwritten policy of nonannexation of industrial areas began in the 1930s. This document also discusses the various economic advantages of this arrangement. Industries are more attracted to the area, and the industries make a significant contribution to the economic life of the city. The city does not pay the cost of providing municipal services to the area. Although the city will sell gas and water to industries, industries must bear the cost of bringing these services to their sites. Nor are the industries offered special water or power rates. In the case of CCPC, the facility will purchase treated water, but not gas, from the city.

One city official in the planning department discussed the location of industrial plants outside of the city as having a positive effect on city management and staff requirements (Wenger, 1977). He based his statement on the fact that city building codes were not enforced in these facilities, thus reducing the cost of enforcement by the city. However, the director of the Department of Inspection and Operation, Mr. Bill Hennigs, pointed out that large industrial facilities within city limits are also exempt from city building codes. He stated that large facilities are covered under Occupational Safety and Health Administration (OSHA) requirements, and enforcement of city codes would result in duplication of those enforced by OSHA.

Thus, the only generally acceptable reason given by Corpus Christi officials and chamber of commerce members for the existence of an industrial zone free of city taxes is that it provides an incentive for industries to locate in the area. Yet CCPC officials stated that the effect of this policy on the siting decision was small (Carlton, 1977; Fleming, 1977). Certainly, though given the size of the annual tax savings on a large facility, each year it remains outside of the city's taxing

Map 3

CORPUS CHRISTI PETROCHEMICAL COMPANY  
SITE AND SURROUNDING AREA



Source: Texas Department of Water Resources.

jurisdiction represents a substantial capital gain for the firm. In addition, this policy may play a greater role in the siting decisions of smaller firms with smaller capital bases.

After the specific site area was chosen, local agents were hired to purchase the acreage. The use of a purchasing agent helped to protect the identity of the purchaser, since landowners will sometimes raise their prices if a large company is interested. The retaining of local agents also reflects the tendency of companies to hire local specialists, including consultants and lawyers who are known and trusted in an area or who know local and state officials.

The land surrounding the site purchased by CCPC is primarily agricultural, although there is some residential development within two miles. The site is within the taxing jurisdiction of the Tuloso-Midway and Calallen School Districts. While CCPC owns 1,200 acres at the site, less than a third of this will be used for the facility. It is likely that CCPC may offer sites to other companies, particularly ones which would buy CCPC's products.

## 7. THE CCPC PERMITTING PROCESS

The construction and operation of petrochemical process plants require a variety of state and federal permits. In general, few Texas cities require facilities to obtain natural resource-related permits in order to build or operate within their jurisdiction. The environmental affairs coordinator for Champlin, who played a major role in the permitting of CCPC, reported that up to the present, direct contact with city officials has been minimal (Hutchinson, 1978). Apparently, staff of the Corpus Christi Industrial Commission have worked with city officials in matters relevant to CCPC. At a later date, CCPC will work directly with the city when purchasing pipeline right-of-way across city property. In contrast to the few, if any, local permits required, state and federal permits which CCPC needed to obtain were far more numerous and complex. The following discussion focuses on these state and federal permits.

The CCPC complex will ultimately include four separate operations:

1. The ethylene plant
2. Barge dock, storage tank farm, and tank car terminal
3. Pipeline distribution facilities
4. Salt dome storage facilities

The design of the latter three is not complete, and to this date CCPC has applied only for the construction permits for the ethylene plant. (Between completion of the study and publication, CCPC had applied for and received a permit for the barge dock facility from the Texas Air Control Board (TACB). Applications for permits for the pipeline and salt dome facilities have also been submitted to TACB and the Corps of Engineers.) Operating permits will not be applied for until the plant is completed and operational. The permits that may be necessary for the operation of the plant and the additional facilities will be discussed briefly in this section, but the lack of design and technical data makes specific discussion impossible.

There are a number of distinct categories into which permits fall. In this study, two of the basic types of permits will be discussed in depth. These are air quality permits and water quality permits. Within each of these types, certain permits must be obtained from the state while others are issued by federal agencies. The following discussion divides the permits required for construction of the CCPC ethylene plant into state and federal permits.

## STATE PERMITS

### AIR QUALITY

On October 13, 1976, Champlin Petroleum Company applied to the Texas Air Control Board for a permit to allow construction of an ethylene plant in Corpus Christi. The plant is in TACB Region 5, which extends from Corpus Christi to Victoria and in which the ambient air quality does not meet federal standards. The Texas Air Control Board, which is empowered by the state to require permits of facilities that will have air emissions, has historically tried to work with industry. This is not to say that the TACB has compromised any standards; rather, the TACB has provided advice to industry on how to achieve the lowest possible emission rate by incorporating the best available control technology. Historically, the TACB has not agreed with the Environmental Protection Agency (EPA) on the need for reducing ozone pollution down to the level of the federal standards or on the effectiveness of the hydrocarbon emissions control policy. To quote the view of one official of a petrochemical company, "TACB has not rolled over and played dead to EPA." Thus, generally TACB has worked with industries in the siting and permitting of new plants.

On January 20, 1977, TACB issued Champlin Petroleum Company a permit (#C-4682) for construction of the plant. The specific conditions primarily involved monitoring and design requirements. A letter to TACB from the Corpus Christi-Nueces County Department of Public Health and Welfare, Public Health Division, after review of the application, expressed concern over storage and the handling of spent caustic. One of the special conditions of the CCPC permit was a requirement that CCPC forward more detailed engineering data on spent caustic disposal (when it became available) and that abatement equipment approved by the TACB executive director be installed before operations.

There is only one known protest to TACB over construction of the plant. In a letter to this agency, Fred Burkhardt, Jr., an adjoining landowner, objected to the odor and fumes from the facility and to the deterioration of his property's value. In a reply letter to Mr. Burkhardt, TACB reported a permit had been granted to the company three weeks before Burkhardt's letter was received. To quote TACB's reply, "It is our opinion that the impact upon existing air quality in the area will be minimal," but that if TACB discovered a violation of their rules and regulations by this facility, "appropriate action will be initiated to insure compliance" (TACB, March 7, 1977).

In February of 1977, Champlin requested that their permit be re-issued in the name of Corpus Christi Petrochemical Company (Champlin, February 9, 1977). As modifications in the design of the plant are made, these must be submitted for review by TACB and incorporated into the existing permit. The EPA's ruling on emission offset resulted in CCPC filing a revised permit application, as will be discussed later.



Within 60 days after achieving normal operation, the company must file for a TACB operating permit.

#### WATER QUALITY

The discharge of surface water requires a permit from both the Texas Department of Water Resources (TDWR), formerly the Texas Water Quality Board (TWQB), and from the Environmental Protection Agency. An application was made by CCPC to TDWR on March 10, 1977 for a permit to allow for the discharge of sanitary waste and vehicle and equipment washdown waste water during the construction phase.

The permit was granted after a June 30, 1977 public hearing. Adjacent landowners, Fred and James Burkhardt, and their lawyer, Perry E. Burkett, protested the discharge of waste into a ditch which crosses their property (TWQB Document, July 18, 1977). TWQB overruled the protests, citing the fact that the ditch already receives sewage. The permit (#02075) was approved by the Texas Water Quality Board on August 11, 1977. This permit allows only for the discharge of treated domestic wastewater from a package treatment plant into drainage ditches which flow into Oso Creek.

#### FEDERAL PERMITS AND REQUIREMENTS

#### AIR QUALITY

On June 3, 1977, the administrator of the EPA ruled that CCPC was in violation of certain parts of the Clean Air Act. Specifically, EPA maintained that the TACB construction permit was invalid since CCPC had not demonstrated that its air pollution emissions would be offset by equivalent or greater emissions reduction in the same area. CCPC was one of the first Texas companies to be held in violation by EPA. However, this was probably more the result of the timing of the permit application than of the specific project. CCPC argued that the company had applied for its permit before December 21, and thus was not a new source. EPA rejected this argument and a conference was held on June 29, 1977.

CCPC was well represented at the conference, as was EPA. The 179 page document, which contains the minutes of the conference, is on file with EPA in Dallas. Obviously, it is not possible to recount a full description of the conference, but the following material briefly summarizes the minutes of this meeting.

The meeting began with EPA outlining its authority to apply its offset policy to this project. EPA presented its findings of a dispersion

modeling study for particulate emissions which showed a great impact on the surrounding area. Interestingly enough, EPA's modeling had been based upon an incorrect plant location. This modeling error was indicative of a number of instances where the EPA's technical information appeared to be confused or inaccurate.

CCPC then presented the findings of its modeling which showed minimum impact from the facility's emissions. CCPC argued that since the actual plant site was located in a portion of an air quality region which attained the federal standards for particulate matter, the facility would satisfy the emissions offset requirements. While portions of the region did not meet federal standards, CCPC contended that the location of its facility would not impact these areas and, thus, would not exacerbate federal standards. EPA agreed to take this information under advisement. Throughout the meeting, TACB staff members participated in the discussion only when asked specific questions.

In summary, EPA agreed to reconstruct its modeling on particulate matter emissions for the facility. EPA requested that CCPC furnish further information on fugitive emissions of hydrocarbons (pumps, valves, compressors, and flanges) and to estimate the quantity of hydrocarbons which will be flared over a year. The EPA also requested CCPC to complete a new TACB permit which showed revised hydrocarbon and particulate matter emissions.

In late November 1977, EPA broke off emission offset negotiations with all companies which had been held in violation (including CCPC) and instructed them to go through the appropriate state agency in order to obtain the necessary permits and to negotiate required offsets. On January 9, 1978, the Texas Air Control Board, after receiving preliminary approval from the Environmental Protection Agency, approved a change in the state regulations which was modeled on the EPA's interpretive ruling on emission offsets (Federal Register, December 21, 1976). The TACB redrafted the permit for CCPC, incorporating those changes required by EPA.

In June 1978, a hearing was conducted by the Texas Air Control Board concerning a reduction of 246.6 tons of hydrocarbon emissions from Champlin Petroleum Company's Corpus Christi refinery. This reduction would offset the emissions resulting from the ethylene production and barge loading facility to be constructed by the Corpus Christi Petrochemical Company pursuant to Texas Air Control Board permits C-4682A and C-5633.

The emission reduction proposed by Champlin would result from (1) removal of an existing 12,000 barrel per day (BPD) vacuum distillation unit from operation and (2) dedication of an existing 300,000 barrel gasoline storage tank exclusively to storage of No. 2 fuel oil or any fluid with a vapor pressure less than or equal to that of No. 2 fuel oil. Ceasing operations of the 12,000 BPD vacuum distillation unit would eliminate at least 139 tons per year of hydrocarbon emissions

from the Champlin refinery. Dedication of the 300,000 barrel gasoline storage tank to No. 2 fuel oil or any fluid with an equivalent or lower vapor pressure would reduce hydrocarbon emissions by at least 107.6 tons per year.

Texas Air Control Board permits C-4682A and C-5633 limit emissions from the CCPC ethylene production and barge loading facility to 188.7 tons per year. The total hydrocarbon emission reduction of 246.6 tons per year offered by Champlin is significantly greater than the CCPC emissions. This reduction represents reasonable progress toward attainment of the national ambient air quality standards for photochemical oxidants and will result in a positive net air quality benefit in Nueces County, which presently exceeds the national ambient air quality standards for photochemical oxidants. Champlin agreed to achieve the offered 246.6 tons per year hydrocarbon emission reduction before the date on which the CCPC project commences operation, which is anticipated to be no later than October 1, 1979.

The Texas Air Control Board found that the hydrocarbon emission reduction offered by Champlin Petroleum Company complies with the applicable state and federal laws and the policies of the Texas Air Control Board regarding emission offsets in nonattainment areas. TACB thus issued Board Order No. 78-6 to that effect.

Also, under the Federal Air Pollution Control Act, new steam generators are subject to new source performance standards (NSPS) and an EPA inquiry. This inquiry requires the new source company to provide an environmental impact statement and assessment. The CCPC facility will contain four generators or boilers. A preliminary environmental study was done by a private firm. CCPC requested EPA to determine if these boilers were subject to NSPS. In April of 1977, EPA ruled that the boilers were not subject to these standards, since they would burn pyrolysis fuel oil. EPA ruled that this type of fuel oil is a nonfossil fuel, and only fossil fuel boilers are subject to NSPS. However, since CCPC might burn some amount of fossil fuel, the company was required to report quarterly that 100 percent fossil fuel was not burned in a unit, thus eliminating the need to continually monitor the units.

#### WATER QUALITY

The Federal Water Pollution Control Act requires that, in order to discharge into navigable water, a National Pollution Discharge Elimination System (NPDES) permit must be obtained. At the present time, EPA administers the NPDES permit, although it may delegate its authority to TDWR in the future. CCPC has applied for an NPDES permit in order to discharge effluent into the inner harbor of Corpus Christi and expects to receive a permit by late 1978 (Hutchinson, 1978).

## OTHER PERMITS

There are a number of other federal permits for which CCPC will ultimately apply during the construction phase of this plant. They will apply to the National Flood Insurance Program for floodplain insurance for facilities within the 100 year floodplain, and to the Corps of Engineers (COE) for a permit to construct a wastewater effluent structure below mean high tide. The latter permit will allow for construction of a pipeline for the discharge of effluent into the Corpus Christi inner harbor. Permits of this type are required if a pipeline will intrude into a channel below the mean high tide. CCPC will probably also request that COE make a site visit to ensure that the site is not within a wetlands jurisdiction area. Section 404 of the Federal Water Pollution Control Act gives the Corps jurisdiction in this determination. It is unlikely that the site will be defined as a wetlands jurisdiction area.

## PERMITS FOR ASSOCIATED OPERATIONS

As previously mentioned, the proposed plans for the CCPC facility actually involve four separate operations. One of these, the ethylene processing plant, and its necessary permits is discussed above. Another operation is the barge dock. The Corps of Engineers (COE) has issued CCPC permits for the barge dock and related operations in compliance with Section 10 and Section 404 of the Federal Water Pollution Control Act. The barge loading facility has also been permitted by the Texas Air Control Board. To date, no permit application has been submitted by CCPC to the Texas Department of Water Resources.

Permits which may be applied for relating to the pipeline distribution and the salt dome storage facilities are indicated in Table 1. To date, CCPC has applied for the site-injection well permit for the salt dome storage facilities. This application is being processed. The remainder of the permits may be required, depending on the specific design and technical information associated with these operations.

Table 1  
FUTURE PERMITTING OF ASSOCIATED OPERATIONS

| <u>Operation</u>                    | <u>Level of Permit<br/>And Applicable Regulations</u>  | <u>Agency</u>                   |
|-------------------------------------|--|---------------------------------|
| Pipeline Distribution<br>Facilities | Federal: Section 10 permit and<br>Section 404 permit are required <u>if</u><br>pipelines cross rivers          | Corps of<br>Engineers           |
|                                     | State: Easements for pipelines<br>over state property - submerged<br>lands                                     | General<br>Land<br>Office       |
| Salt Dome Storage<br>Facilities     | Federal: Section 10 permit and<br>Section 404 permit are required<br><u>if</u> facilities are in wetland areas | Corps of<br>Engineers           |
|                                     | State: Site-injection well permit  | TDWR                            |
|                                     | State: Approval of dikes or<br>levees constructed  | TDWR                            |
|                                     | State: Permit to operate surface<br>brine pits   | Texas<br>Railroad<br>Commission |
|                                     | State: Construction and operating<br>permits for sources of air<br>contaminants                                | TACB                            |

## 8. OPPOSITION TO THE CCPC FACILITY

There has been little vocal opposition to the siting of the CCPC plant in the Corpus Christi area. Two adjacent landowners did protest the location of the plant to TACB and TDWR, as discussed in the section on state permits. While this is the only known instance of organized opposition to the project, some citizens did raise the broader question of the desirability of further industrial growth.

Located as it is on the Gulf of Mexico and with its proximity to the Padre Island National Seashore, Corpus Christi enjoys a favorable tourist climate. In fact, the city's voters recently passed a bond issue to allow for the construction of a convention center and expanded tourist facilities. At the present time, the tourist industry contributes significantly to the local economy, and there is every reason to believe this trend will continue.

Some citizens did question the effect of further industrial development on the tourist industry. These individuals pointed to the effects of industrial plants on the environment. Since these facilities tend to be increasingly mechanized and to be located outside the city limits, they felt tourism offered greater economic advantages to the community as a whole. However, these issues were raised in private discussions, in relation to general industrial development rather than to this specific facility.

## 9. LOCAL IMPACTS OF THE CCPC FACILITY

There are a variety of impacts, both positive and negative, which could occur as the result of construction and operation of a large petrochemical complex. This discussion will consider only the more obvious impacts; detailed analysis of impacts is beyond the scope of this study. The discussion will focus on the CCPC facility and specifically the ethylene plant, because technical and location information are not available on the other proposed operations (i.e., the tank farms, barge docks, pipelines, etc.). It should be stressed that the siting of a similar plant in another community might raise an entirely different set of impact issues. A small rural community would certainly be affected differently by such a facility than would be a large metropolitan area such as Corpus Christi. With a population of over 280,000 in the metropolitan area and long-term experience with industrial development, Corpus Christi has knowledge of and some control over the possible effects of such a facility.

### ENVIRONMENTAL IMPACTS

There are two obvious environmental impacts which may result from the operation of the CCPC ethylene plant - the possibility of changes in the air and water quality in the area. Certainly, petrochemical processing plants have negatively affected the air and water quality of some communities in the past. Recent legislation has, however, been toward minimizing the destruction of air and water quality. As discussed in other sections of this study, the EPA has the power to enforce federal air and water quality standards, and state agencies have the power to require industries to meet even more stringent air and water quality standards.

There appears to be little data to support a case for the destruction of water quality in the instance of CCPC. The plant is equipped with its own water treatment facility, which should remove potentially damaging compounds from effluent discharge, and as planned, the facility will not discharge a significant amount of treated effluent, if any, into the city's treatment system (Hutchinson, 1978).

While the impact of the facility on water quality does not appear to be a significant issue, the question of water availability is worthy of discussion. The plant will purchase treated water from the city

of Corpus Christi, which could experience shortages in the future if Choke Canyon Dam is not constructed. According to one concerned resident of the area, industrial development of this type depletes the future availability of water for residential use (Frishman, 1977). However, should water shortages occur, the city's residential customers would have priority over industrial customers.

The impact of CCPC on the air quality in the area is a more complex question. The air quality in this region is below EPA standards, although the problem is not severe. The predominantly southeasterly winds tend to disperse air emissions over primarily nonresidential areas, but the enforcement of EPA offset is designed to ensure no further destruction of the air quality in the area. Although CCPC has attempted to reduce emissions from the plant to an acceptable level, there will be emissions.

Of course, CCPC is not the only source of industrial emissions. There are numerous other facilities within five miles of the CCPC site; however, EPA's focus on new facilities has often led to tighter control over these than over existing emission sources.

#### ECONOMIC IMPACTS

There are a number of possible economic impacts which may result from the location of the CCPC facility. Certainly, the plant will provide jobs for a number of local residents. However, there will be few long-term job opportunities. The construction of the plant may provide up to 2,600 jobs for skilled and unskilled labor, but these will be only temporary. The operation phase of the plant should provide 250 to 300 jobs, and some of these positions will probably be filled by newcomers to the area. Without knowing the origin of residence and the period of time of employment, the number of indirect jobs created by the facility cannot be calculated. However, large petrochemical complexes have generally resulted in numerous satellite industries springing up. Thus, while the number of direct job opportunities may be relatively small in number, a significant number of induced jobs may be generated by the construction of the CCPC facility.

The location of the plant outside of the city limits has a number of advantages and disadvantages which have been discussed previously. While the plant will not be taxed by the city, it will purchase water from the city. The company is responsible for bearing the cost of extending this service to the site, but city-generated revenues from these sources will be slight. In general, it is difficult to detect any direct economic benefits to the city as a result of the plant's location.

The plant will be taxed by the county and two school districts (parts of the plant site lie within the boundaries of two districts). Taxes paid by the company to the Tulosso-Midway and Calallen school districts should significantly increase their revenues. At the same time, it is doubtful that the school districts' enrollments will increase



significantly because of the plant. In fact, it is likely that most new residents will locate within the boundaries of the Corpus Christi Independent School District, since this system serves most of the residents in the area. Thus, while Tuloso-Midway and Calallen may receive the tax revenues, Corpus Christi will probably receive most of the new students. However, given the small number of new residents associated with this plant, the number of new students should not dramatically affect the Corpus Christi School District.

The increased traffic in the area will probably require the construction of new roads and increased maintenance of others. Two of the major roads adjacent to the site are state roads, but the remainder are the county's responsibility. Although the construction of the plant will result in the need to expend funds on these roads, it is doubtful that the impact on the county will be fiscally negative.

The possibility of industrial growth negatively affecting the tourist industry in the area has been discussed previously. The alteration of the physical environment would probably reduce its appeal to tourists. Yet it is difficult to directly link this specific facility to any decline in tourism. It is outside the normal tourist "beat," and it is only one plant out of many. Nevertheless, the cumulative effect created by a number of similar facilities could significantly impact the region.

## SOCIAL IMPACTS

Given the population size and general characteristics of the Corpus Christi area, it is doubtful that the plant will have far-reaching social impacts on the community. The urban nature of the area and the historical industrial development would suggest the area to be a highly diversified community which is accustomed to industrial development. However, the specific site chosen for the CCPC facility does raise certain broad impact questions. Traditionally, industrial development in Corpus Christi had clustered within the industrial zone near the port. The location of this plant in what was basically an agricultural and residential area may adversely affect the lives of nearby residents. While the value of their land may ultimately rise, the character of the neighborhood will change. There is certain to be increased traffic, noise, and a certain amount of air pollution in the immediate area. The location of this plant may have a significant impact on land use patterns in the area by beginning a conversion to increased industrial development.

## 10. SUMMARY

Corpus Christi Petrochemical Company is representative of the growing trend for oil and chemical companies to diversify into the petrochemical sector. The large size and capacity of the plant and its dependence on liquid feedstock also make it illustrative of the future of the petrochemical industry. CCPC, like many other petrochemical plants, has chosen to site near its raw materials and markets. This proximity, the ability to obtain the necessary permits in some areas, and the generally favorable business climate are probably the major incentives for a petrochemical facility to site in Texas. The factors which affect the choice of one specific site over another are peculiar to some extent to each specific facility.

In the case of CCPC, it is likely that the siting decisions were significantly affected by the location of the parent companies' facilities. The company could have chosen to locate either near its markets or near its feedstock source. Its decision to pick the latter site was certainly affected by Champlin's knowledge of and strong commitment to the Corpus Christi area. The company's major goal was to get a piece of the burgeoning petrochemicals market. The increasing profitability of this industry coupled with the relative lack of government regulation in relation to product, particularly price of product, has made this industry attractive to investors.

In general, though, the company appeared to make its decision on criteria not unlike those that are used by any home buyer. It assessed its particular needs and sought a location where it could obtain land at a reasonable price. The facility required some amount of fresh water, power, and accessibility to transportation systems. The company looked for a site on which governmental agencies would allow it to build. In other words, ease of acquiring permits was an important consideration. Labor availability and construction and operating costs were also considerations. The area was considered a nice place for employees to live. Thus, while CCPC's siting requirements and decision-making process were in certain ways unique, their general areas of concern are certainly mirrored in the siting decisions of other petrochemical companies.

## REFERENCES

- Allen, B. 1977. Corpus Christi Industrial Commission. Personal interview, October 1977.
- Burkhardt, F., Jr. 1977. Correspondence to Executive Director, Texas Air Control Board, February 14, 1977.
- Carrier, R.E., and W.R. Schriver. 1968. Location theory: An empirical model and selected findings. In Land Economics, November 1968.
- Carlton, R., CCPC Facilities Project Director. 1977, 1978. Personal interview, October 1977; personal communication, 1978.
- Champlin Petroleum Company. 1977. Correspondence to Texas Air Control Board, February 9, 1977.
- Chemical Engineering. 1976. McGraw-Hill, Inc.
- Chemical Systems, Inc. 1976. Structure and Competition Within the Petrochemical Industry and Economic Impact of the 1973-74 Petrochemical Shortage. Prepared for the Federal Energy Administration, March 1976.
- Corpus Christi Caller-Times. 1976, 1977. Articles on CCPC, 1976 and June 2, 1977.
- Corpus Christi Chamber of Commerce. 1976. It's A Good Move to the Sparkling City By The Sea. Corpus Christi, Texas.
- Corpus Christi Goals Commission. 1975. Choices Facing Corpus Christi.
- Corpus Christi-Nueces County Department of Public Health and Welfare, Public Health Division. 1977. Correspondence to Texas Air Control Board, November 18, 1977.
- Corpus Christi Petrochemical Company. 1977. Correspondence to the Environmental Protection Agency, February 24, 1977; March 7, 1977; June 28, 1977.
- Davis, J.C. 1977. Chemical and oil firms: a boom in betrothals. In Chemical Engineering, August 30, 1977.
- Durham, J., Central Power and Light, Area Development Department. 1977. Personal interview, October 1977.
- Environmental Protection Agency. 1977. Correspondence to CCPC and minutes of discussion, June 28, 1977.
- Escott, F. 1964. Texas Plant Location Survey 1955-1963.
- Fleming, A., CCPC Deputy Facilities Project Director. 1977, 1978. Personal interviews, November 1977; May 1978.

- Frishman, S., Coastal Bend Conservation Association, Corpus Christi, Texas. 1977, 1978. Personal interviews, October 1977; July 1978.
- Harris, B., Organization for the Preservation of an Unblemished Shoreline, Corpus Christi, Texas. 1978. Telephone interview, July 1978.
- Hennings, B., City of Corpus Christi, Director of the Department of Inspection and Operation. 1978. Telephone interview, February 1978.
- Higgins, B., Texas League of Women Voters, former President. 1978. Personal interview, July 1978.
- Houston - Gulf Coast Chemical Directory, 1974-1975.
- Hutchinson, J., Champlin Petroleum Company, Environmental Affairs Coordinator. 1978. Personal interview, February 9, 1978.
- Matthews, D., City of Corpus Christi, Director of Utilities. 1977. Personal interview, September 20, 1977; Telephone interview, January 24, 1978.
- Nishioka, H., and G. Krumme. 1972. Location conditions, factors and decisions: An evaluation of selected location surveys. In Land Economics.
- Nueces County Navigation Committee. 1973. Port of Corpus Christi Port Book. Corpus Christi, Texas.
- Oil and Gas Journal. 1978. U.S. ethylene to grow at 6.5%/year. November 22, 1978.
- Peterson, Mrs. P., Audubon Outdoor Club of Corpus Christi. 1978. Telephone interview, July 1978.
- Petrochemical official (anonymous). 1977. Personal interview, November 1977.
- RPC, Inc. 1978. Texas Natural Resources Reporter. Austin. January 1978.
- Stokes, B., Legal Division, Environmental Protection Agency. 1977. Personal interview, October 18, 1977; telephone interview, November 1977.
- Suter, H., Sierra Club, Corpus Christi, Texas. 1978. Telephone interview, July 1978.
- Texas Air Control Board. CCPC file. 1976-1978.

Texas Water Quality Board. CCPC file. 1976-1978.

Tischler, L., Engineering Science, Inc. of Austin. 1977. Personal interview, November 1977.

Wenger, L., City of Corpus Christi, Dept. of Planning. 1977. Personal interview, October 1977.

Whitehorn, N.C. 1973. Economic Analysis of the Petrochemical Industry in Texas. May 1973.

**DATE DUE**

|         |          |  |                   |
|---------|----------|--|-------------------|
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
|         |          |  |                   |
| GAYLORD | No. 2333 |  | PRINTED IN U.S.A. |

|         |          |
|---------|----------|
| GAYLORD | No. 2333 |
|---------|----------|

PRINTED IN U S A

NOAA COASTAL SERVICES CENTER LIBRARY



3 6668 14106 5807